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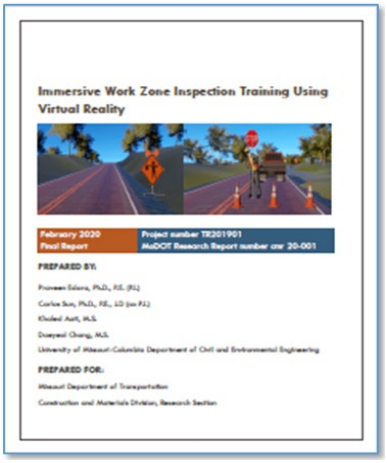
Research Summary

Immersive Work Zone Inspection Training Using Virtual Reality

The Work Zone Safety and Mobility Rule (23 CFR § 630 Subpart J) established requirements and offers guidance to state transportation agencies for addressing the traffic safety and mobility impacts of work zones. As per § 630.1008(d), "Training: States shall require that personnel involved in the development, design, implementation, operation, inspection, and enforcement of work zone related transportation management and traffic control be trained … States shall require periodic training updates that reflect changing industry practices and State processes and procedures" (FHWA 2004).

Figure. Participant wearing VR Headset to inspect work zone signs

Work zone management has incorporated the use of new technologies. For example, the use of Intelligent Transportation Systems and application of simulation tools for impact analysis and scheduling has risen in the past decade. In contrast, work zone training has not taken advantage of new technologies that could improve training effectiveness, immersion, cost, availability, and flexibility.



Work zone inspection is an essential process for ensuring the safety of both workers and the traveling public. This annual exercise is demanding, as each work zone is inspected and rated based on several factors. Factors range from proper use of signage, channelizing devices, barriers, and lighting to signalization and traffic management. Any discrepancies from satisfactory performance are also recorded. A rating value is assigned for each factor based on discrepancies and deficiencies.

Inspection staff are trained in several areas. They need to be familiar with the inspection worksheet and the different evaluation categories. They also need to be familiar with the Manual on Uniform Traffic Control Devices (MUTCD) typical applications (TAs) for different facilities and work activities. Finally, an understanding of the discrepancies and deficiencies of various work zone elements is necessary in order to satisfactorily rate them. The aforementioned knowledge attainment requires robust training of the personnel, which is difficult to accomplish without extensive field visits (i.e. prior experience).

The current state of practice is to review the documents related to temporary traffic control and reports from previous inspections, typically power point files with pictures. It would be beneficial if a new mechanism for training could be developed that is as effective as field visits but without the amount of time and effort required to visit multiple field sites. Outdated training practices are also not sufficiently engaging for the future generation

workforce consisting of Millennials, Gen X and Z generations.

This project offers an alternative training platform using virtual reality (VR) and illustrates it using Missouri DOT case studies. The platform consists of two steps. The first step is a *learning* module which is founded on the historical knowledge gained by DOT staff from inspections dating back five years. This knowledge base synthesized representative inspection reports from prior years from all districts including photographs of deficiencies. The synthesized knowledge was converted into a concise, easy-to-consume format for training. The second step is an *immersive* module that places trainees in virtual work zones where their inspection performance will be observed and assessed (e.g., quiz on work zone deficiencies such as poor signage or misaligned cones). Two training scenarios of a freeway work zone were created using the Unity 3D engine and the Oculus Rift VR headset. Participants, wearing a VR headset, are placed in the passenger seat of a vehicle that drives through a work zone. As the participant travels past various signs and temporary traffic control devices, they note any issues.

Figure. A virtual flagger avatar created using motion capture technology and real-world flagger movements

The training platform was tested by 34 individuals that worked for the Missouri Department of Transportation. An overwhelming majority (97%) agreed that virtual reality offered a realistic and effective way to train inspectors. One additional scenario of flagger operations in a two-way one lane work zone was also created for the purposes of training work zone inspectors. The scenario was developed in Unity using drive through video data, mapping software, and motion capture technology for replicating manual flagger movements. The use of flagger scenario in the immersive training module is particularly recommended for staff that inspect work zones in rural areas of the state where two-lane roadways are more prevalent.

Project Information

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